

are so closely allied both to *Cl. ventricosa*, Drap., and *Cl. lineolata*, Heldr., and *Cl. plicatula*, Drap., by the circumstance that the striæ at the back of the throat (cervix) are rather more distant from each other than the striæ of the penultimate whorl. It is distinguished from *Cl. ventricosa* both by its smaller size and the interlamellar plaits (for the true *Cl. ventricosa* never has them); from *Cl. lineolata*, Heldr. (*basiliensis*, Fitzinger), and the other forms allied to *Cl. plicatula*, both by a distinctly marked keel bounded on each side by grooves, and by the absence of the palatal callosity. Nor does it ever possess the rudiment of a lower palatal fold so peculiar to *Cl. lineolata*. We shall enter more fully into this subject in the iconographic monograph which we have undertaken to write on the *Clausiliæ* allied to *ventricosa*, *plicatula*, *rugosa*, and *parvula*.

ADOLF SCHMIDT.

Aschersleben, Oct. 1855.

III.—*Memoir on the Indian species of Shrews.* By EDWARD BLYTH, Esq.* *With Notes by* ROBERT F. TOMES, Esq.

As an incentive to the investigation of some of the most imperfectly known of Indian Mammalia, and not the most inviting of groups to amateur students, we shall here endeavour to bring together, and to reduce or digest into intelligible form and order, the scattered materials available for a monograph on the Indian Shrews.

It may lead to the discovery of additional real species, and probably to the diminution of the number of present supposed species; besides conducing to the further elucidation of those at present known and recognized, and especially to a better knowledge of the extent of their geographical distribution.

In general the Shrews of tropical and subtropical countries are distinguished by their comparatively large size, and slaty hue of every shade from pale grey to black, with rufous tips to the fur more or less developed, though in some scarcely noticeable †; the ear-conch is conspicuously visible above the fur; the tail thick, tapering, and furnished with scattered long hairs, which certain species also exhibit on the body; and the teeth are wholly white ‡, and of the following type of structure.

The superior front teeth or *quasi-incisors* (vide J. A. S. xx. 164)

* From the Journal of the Asiatic Society of Bengal.

† In at least some species, the rufous tips appear to increase with age; and, to a considerable extent, the colour of these animals is darker according to the increase of altitude inhabited by a species.

‡ While preparing this memoir, we discovered a remarkable exception in the instance of *Sorex melanodon*, n. s.

are large and strongly hooked, and much longer than their posterior spur; while the inferior have rarely so much as a trace of a serrated upper edge: of four upper premolars anterior to the *carnassier*, the first is large, the second and third are much smaller, the fourth is diminutive, and the third exceeds the second. This group of Shrews is familiarly exemplified by the common large Musk Shrews of Asia and Africa, and constitutes the restricted SOREX, L. (v. *Pachyura*, De Selys Longchamps*).

The Indian species are as follows:—

1. *S. CÆRULESCENS*, Shaw; *S. pilorides*, Shaw; *S. giganteus*, Is. Geoffroy; *S. murinus*, L., apud Gray: figured in Hardwicke's Ill. Ind. Zool. as *S. myosurus*, Pallas; whence probably *S. myosurus*, apud Walker, in Calc. Journ. Nat. Hist. iii. 255. The common Musk Shrew, or (*vulgo*) 'Musk Rat,' of Bengal, &c. (but different from the 'Musk Rat' or *Muskquash*—FIBER ZIBETHICUS of North America, which is a rodent nearly affined to the Voles—ARVICOLA).

This animal is described by Mr. Hodgson in the Ann. & Mag. Nat. Hist. xv. 269 (1845); but the length of the tail (as given), $3\frac{1}{8}$ in., is possibly a misprint for $3\frac{5}{8}$ or $3\frac{7}{8}$ in., or more than half the length of the head and body, which is given as 6 in. Number of caudal vertebræ 24. Total length of skull of adult male, with front teeth *in situ*, somewhat exceeding $1\frac{5}{8}$ in.; of female, somewhat under greatest breadth of skull of former, $1\frac{1}{6}$ in.; of latter $\frac{5}{8}$ in. Colour uniform pale grey, slightly tinged with ferruginous, and more conspicuously on the lower parts; the naked parts flesh-coloured.

This is the common large Musk Shrew of Bengal, Nepal, and we believe the valley of Asám; becoming rare in Sylhet, and wholly disappearing in Arakan. In Nepal Mr. Hodgson styles

* Certain small species of temperate climates were detached by Wagler from the ordinary Shrews of those climates (with piceous-tipped teeth, &c.) by the name of CROCIDURA (v. *Suncus*, Ehrenberg, apud Gray), e. g. *S. ARANEUS*, *S. LEUCODON*, *S. ETRUSCUS*, &c.; but we are not aware that these are separable from the above, and certainly the various Pigmy Shrews of India are typical SORICES, except that some only of them want the odoriferous glands on the sides of the body.

N.B. In the 'Report on the Quadrupeds of Massachusetts,' published by the Government Commissioners of the Zoological and Botanical Survey of the State (1840), the extraordinary statement is made by Mr. E. Emmons, that "In the specimens of SOREX which have fallen under my observation, I have not been able to discover, even with the microscope, any nostrils, the termination (or extremity) of the nose being apparently an imperforate membrane." Upon reading this we examined several species (large and small) preserved in spirit, and easily detected a lateral valvular orifice, which, on pressure of the snout above, was shown to be perforate, by the fluid oozing through. Could Mr. Emmons have tried so simple an experiment?

it "the common House Shrew of the plains, and also of the hills up at least to 6000 feet." We have seen specimens from the neighbourhood of Agra; but whether it be the common Musk Shrew of South India is doubtful on present evidence, though Dr. Kelaart's description of the Cingalese animal corresponds. It certainly does not appear to inhabit the eastern coast of the Bay of Bengal, from Arakan to the Straits of Malacca. Dr. Horsfield gives as its habitat "India generally, and the eastern islands;" and he notes a specimen from Butan presented to the India-House collection by Major Pemberton. We suspect that its reputed existence in the Malay countries needs confirmation.

In addition to the names above cited, Dr. Gray in his Catalogue of the specimens of Mammalia in the British Museum (1843) refers the following name and synonyms to this species: *S. MURINUS*, L.; *S. myosurus*, Pallas; *S. indicus* et *S. capensis*, Geoffroy; *S. Sonneratii*, Is. Geoffroy; *S. crassicaudatus*, Lichtenstein; *S. nipalensis*, Hodgson, and *S. moschatus*, Robinson. The last two are merely MS. names; and indeed the zoological appellations in Mr. W. Robinson's 'Descriptive Account of Asam' are given pretty much at random, and would establish a most extraordinary community of species among the Mammalia of that country and of Europe! He gives, "Genus MYGALE. *Sorex moschatus*, Cuvier. The common Musk Rat." Now *Sorex moschatus*, L. (nec Cuvier), is the type of the genus MYGALE of Cuvier; altered to MYOGALEA, Fischer (*Myogale* apud Rüppell), because pre-occupied by Linnæus for a well-known genus of spiders; and MYOGALEA MOSCHATA is a Russian animal, generically differing from Mr. Robinson's Musk Shrew. Nevertheless his adoption of the term *moschatus* would seem to indicate the rankly-smelling *S. CÆRULESCENS* rather than *S. MURINUS* (v. *myosurus*), which is the only Shrew mentioned in Prof. Walker's list of the Mammalia of the same province.

S. INDICUS, Geoffroy, v. *S. Sonneratii*, Is. Geoffroy, is accepted as a distinct species from *S. CÆRULESCENS* in Dr. Horsfield's Catalogue of the specimens of Mammalia in the India-House Museum (1851); and a specimen is noted from the Dukhun, presented by Col. Sykes, and the following habitat given for the species—"Continent and islands of India." Col. Sykes terms it the *Chuchouder* of the Mahrattas; being the same name which is applied to *S. CÆRULESCENS* in Bengal, spelt *Choochundr* by Dr. Cantor (J. A. S. xv. 191); and the latter author gives "*Chinchorot* of the Malays of the Peninsula," as the name of the very distinct species referred by him and others to *S. MURINUS*, L.; which latter was originally described from Java. According

to Col. Sykes these troublesome and disagreeable animals are very numerous in Dukhun, but much more so in Bombay. The sebaceous glands in an old male were observed to be very large, and the odour of musk from them almost insupportable; while in an adult female the glands were scarcely discernible, and the scent of musk very faint. [It is tolerably strong in the female of *S. CÆRULESCENS*; though more or less so, perhaps, with reference to sexual condition.] “The *SOREX INDICUS* and *S. GIGANTEUS*,” it is added, “are regarded by Col. Sykes as specifically identical, he having killed them in the same room, and seen them frequently together.” (P. Z. S. 1831, p. 99.) Prof. Schinz accordingly assigns *S. GIGANTEUS*, Geoff., Ann. du Mus. xv. pl. 4. f. 3, as a synonym of *S. INDICUS*; but the reference is erroneous, the ‘Mémoires du Muséum,’ tom. xv. (to which we have not access) being probably intended. *S. GIGANTEUS*, Is. Geoff., Voy. de Bélanger, refers to *S. cærulescens* of Bengal.

According to M. Isidore Geoffroy, the *S. INDICUS* (his *S. Sonne-ratii*) is a smaller animal than *S. CÆRULESCENS* (his *S. giganteus*), with tail forming always a quarter of the entire length. Length of head and body of adult a little under 4 in. (Fr.). Fur ashy, washed with russet-brown, and pale ashy below. Inhabits the Coromandel coast and also the Mauritius. If truly a distinct species from *S. CÆRULESCENS*, its natural habitat is probably W. India; but we have vainly sought for information of such an animal.

In Dr. Rüppell’s printed Catalogue of the specimens of Mammalia in the Frankfort Museum (1842), examples referred to *S. INDICUS*, L. (Fr. Cuv. Mamm. ii. t. 28), are noted from Java, and also from Massoua and from Suez; and a supposed variety, termed by him *S. INDICUS*, var. *cinereo-ænea*, from Schoa; and he elsewhere suggests that these animals have probably been introduced by the shipping from S.E. Asia and its islands, and so found their way even to Schoa, where a different climate had effected the colouring of the fur. On ship-board they could of course subsist on *Blattæ*; but their presence (certainly that of the fœtid *S. cærulescens* of Bengal) would scarcely escape remark, the more especially as that of a single individual might seriously damage a whole cargo; besides the obvious necessity of both sexes being required to continue the race, a condition most likely to be fulfilled by the conveyal of a pregnant female with her future litter of some five or six. *S. CRASSICAUDUS* (nec *crassicaudatus*), Lichtenstein, refers to a Musk Shrew inhabiting Egypt, and stated to be common about Suez, which may therefore be presumed identical with Dr. Rüppell’s *S. INDICUS* from Suez; and the description certainly seems to approximate that

of *S. CÆRULESCENS* (length $5\frac{1}{2}$ in. ; tail $2\frac{3}{4}$ in.) : and *S. CAPENSIS*, Geoffroy, is termed *S. FRANCINUS* by Prof. Schinz, who gives Mauritius as its habitat (length $3'' 8'''$; tail $1'' 9'''$). The most notable identification is that of Dr. Rüppell's specimens from E. Africa and from Java, presuming the latter to be really from that island.

2. *S. MURINUS*, L. ; *S. myosurus*, Pallas ; *S. cærulescens*, var., Raffles ; *S. Griffithii* (?), Horsfield ; the common Malayan species originally described from Java, and by Dr. Cantor in J. A. S. xv. 191, and thus denominated by him after Prof. Schinz (Synopsis Mammalium), who states it to inhabit Java, Sumatra, Borneo, Celebes, Amboyna, Japan, Bengal, Abyssinia, and the Cape of Good Hope.

We have italicized the habitats which probably need verification : and the Society possesses specimens from the Arakan and Khásya Hills, which accord with Dr. Cantor's description, *l. c.* ; but less so with M. Geoffroy St. Hilaire's figure in the Annales du Muséum d'Histoire Naturelle, tom. xvii. pl. 3. f. 2, which may nevertheless be intended to represent the same species. As compared with a mature female from Arakan, taken out of spirit, the ears in M. Geoffroy's figure are represented too small, and neither the snout nor tail is sufficiently elongated. Length of this Arakan female—head and body 5 in., and tail 3 in. ; hind-foot (with claws) $\frac{7}{8}$ in. Unfortunately we have no Malayan specimen for actual comparison ; but there is every reason to suspect that this species replaces *S. CÆRULESCENS* along the whole eastern coast of the Bay of Bengal, and thence through the hilly country northward to that skirting the valley of Asam. Dr. Horsfield mentions a Nepalese specimen presented to the India House by Mr. Hodgson ; but this species is unnoticed in the latter gentleman's Catalogue of Nepalese animals, and especially in his descriptive notices of the Nepalese Shrews, Ann. & Mag. Nat. Hist. xv. 269.

With the exception of the small *S. TENUIS*, S. Müller, from Timor, it appears to be the only well-established species of Shrew throughout the great Oriental archipelago. In the Tenasserim provinces, the Rev. J. Mason states—"We have at least two species of Musk Shrew, both of which emit an offensive odour." (Qu. *S. MURINUS* and *S. SERPENTARIUS*?) In *S. MURINUS*, according to Dr. Cantor, "the smell of musk emitted by the adult animal, and which in the young is barely perceptible, is much less intense than in the Bengal Musk Shrew." *S. SERPENTARIUS*, according to Dr. Kelaart, has a powerfully offensive musky odour. *S. MURINUS* has longer ears than *S. CÆRULES-*

CENS; and Dr. Cantor describes it as—"Dark brownish-grey above, beneath light brownish-grey. Feet and tail flesh-coloured in the living animal, changing to cinereous after death. In the young the colour is more of a bluish-grey, slightly mixed with brown on the back." A stuffed specimen from the Khasya Hills has the fur longer and less dense than in *S. CÆRULESCENS*, the piles somewhat curly, and colour dark ashy at base, with rufous-brown tips, which give the prevailing hue. A most obviously distinct species from *S. CÆRULESCENS*.

We suspect that *S. Griffithii*, Horsfield, of that naturalist's Catalogue of the specimens of Mammalia in the Honourable Company's Museum, is no other than our presumed *MURINUS* from the Arakan and Khasya Hills, although described from Afghanistan, because we saw a fine skin from Cherra Punji in the possession of the late Mr. Griffith, which was forwarded to the India House by Mr. M'Clelland; and we have previously had occasion to remark, that specimens of reptiles procured by Mr. Griffith in Afghanistan and in the Khasya Hills, had manifestly become mixed and confounded; whence certain important mistakes concerning habitats*. *S. Griffithii* is described to be affined to *S. MURINUS*; "but differing essentially by the uniform deep blackish-brown tint, and the shortness, delicacy and softness of the fur. Colour deep blackish-brown throughout, with a slight rufous reflection in a certain light. Length of head and body, $5\frac{3}{4}$; tail, $2\frac{1}{2}$ in."—Horsfield's Catalogue.

[From a careful examination of the specimens of *S. CÆRULESCENS* and *S. indicus* mentioned by Dr. Horsfield in his Catalogue of the Mammalia in the Museum of the East India Company, I am quite persuaded that they are identical, the latter differing from the former in having the fur of the back somewhat more tinged with rufous, and the animal in its mounted state being rather smaller, but the head, teeth and feet are of similar dimensions. With respect to the comparative length of the tail, no safe conclusion can be formed from specimens from which the bone has been extracted, and the form reproduced according to the fancy of the stuffer.

The specimen of *S. MURINUS* above alluded to by Mr. Blyth differs only from the above-mentioned species in having the fur much longer, being nearly twice the length, amounting to 4''' , whilst the fur of *S. CÆRULESCENS* scarcely exceeds 2''' in length. The colour also is somewhat darker and browner.

The dimensions of the three specimens in Dr. Horsfield's Catalogue are as follow :—

* Vide J. A. S. xxii. 413.

	<i>S. cærulescens.</i>	<i>S. indicus.</i>	<i>S. murinus.</i>
Head and body about...	6" 6"	" "	" "
Head	1 8	1 7	1 7½
Tail	2 10	2 2	2 6
Fore-arm	10
Fore-foot	5½	6½
Tarsus and toes	9	9½	9

S. GRIFFITHII is a perfectly distinct and well-marked species, remarkable for the large size of its teeth, which exceed those of every example of the great *S. CÆRULESCENS* I have yet seen. I cannot concur with Dr. Horsfield in considering the fur as either short, close or soft, but describe the species thus—Fur of medium length, deep blackish-grey, glossy and rather coarse; ears smaller and more hidden than in *S. CÆRULESCENS*. Front teeth very large. Head and body about 5" 9". Head 1" 7" or 8". Tail 2" 5". Fore-arm 9". Fore-foot 6½". Tibia 11". Hind-foot 10½". Length of lower incisors 3½".—R. F. T.]

3. *S. SERPENTARIUS*, Is. Geoffroy; *S. kandianus*, Kelaart. Described in J. A. S. xxi. 350, from a skin sent by Dr. Kelaart, as "the large godown Shrew of Kandy," though scarcely corresponding with his indications, J. A. S. xx. 164, 185. A second skin of precisely the same species, and also an adolescent specimen entire in spirit, were subsequently forwarded from Mergui by Capt. Berdmore, as noticed in xxii. 412. In both adults the tail (vertebræ) measures 2½ in.; and the head and body (allowing for some extension of the skin) about 4½ in. "The Kandyan specimen is more rufescent than the others, but we can perceive no further difference whatever; indeed, to judge from the two Mergui examples, it would seem that this animal becomes more rufescent with age." Dr. Kelaart states that its odour is as offensive as that of the large Musk Shrew of Ceylon. The Coromandel coast and the Mauritius are given as its habitats. Colour duskyish grey, with dark rufous-brown tips to the fur, more or less developed according to age, and the under parts somewhat paler.

4. *S. SOCCATUS*, Hodgson, Ann. & Mag. Nat. Hist. xv. 270. A Sikim specimen which we refer to this species bears considerable resemblance to the last, but is a good deal darker, with well-clad feet and tail, and the head and limbs are proportionally larger. Entire length of skull with front teeth *in situ* 1½ in.; breadth ¾ in. (nearly); entire range of upper teeth ⅝ in.; ditto of *S. SERPENTARIUS* barely exceeding ½ in. Tail (vertebræ) 2⅜ in.; compressed towards tip, which is furnished with a pencil-tuft of stiffish hairs. Mr. Hodgson thus describes his
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animal—"Size and proportions of *S. NEMORIVAGUS*, H. (nearly), but distinguished by its feet being clad with fur down to the nails, and by its depressed head and tumid bulging cheeks (mystaceal region). Ears large and exposed. Colour a uniform sordid or brownish slaty-blue, extending to the clad extremities. Snout to rump $3\frac{1}{2}$ in.; tail $2\frac{1}{8}$ in.; planta $\frac{1}{8}$ in. This animal was caught in a wood plentifully watered, but not near the water. It had no musky smell when brought to me dead." *Hab.* Nepal and Sikim.

[For further remarks on the synonymy of this species, see a note appended to the account of *Soriculus nigrescens*.—R. F. T.]

5. *S. NEMORIVAGUS*, Hodgson, Ann. & Mag. Nat. Hist. xv. 269. Differs from the ordinary type "by a stouter make, by ears smaller, and legs entirely nude, and by a longer and more tetragonal tail. Colour sooty-black, with a vague reddish smear; the nude parts fleshy-grey. Snout to rump $3\frac{5}{8}$ in.; tail 2 in.; planta $\frac{1}{16}$ in. Found only in woods and coppices." Nepal. According to Dr. Gray, an example presented to the British Museum by Mr. Hodgson, as of this species, "is probably only a half-grown specimen of *S. MURINUS*" (*i. e.* *CÆRULESCENS*)! * The foregoing description should indicate a very different animal, but which might be mistaken for the young of *S. MURINUS* (*verus*), and such probably is the supposed *S. MURINUS* from Nepal of Dr. Horsfield's Catalogue.

[See the note on this last-mentioned species.—R. F. T.]

6. *S. HETERODON*, nobis, n. s. Very similar to *S. SOCCATUS* in general appearance, but less dark-coloured, with shorter fur, and pale instead of blackish feet and tail underneath; the feet, too, are broader, especially the hind-feet, and they have a hairy patch below the heel. The skull, of the same length as in *S. SOCCATUS*, and with equally large teeth, is much more narrow, and the upper quasi-incisors are conspicuously less strongly hooked than in that and other typical *SORICES*. From Cherra Punji in the Khasya Hills.

7. *S. NIGER*, Elliot; described in Dr. Horsfield's Catalogue (1851). "Length of the head and body $3\frac{1}{2}$ in.; of tail $2\frac{1}{2}$ in. Tail equal in length to the entire animal, exclusive of the head, gradually tapering to a point. Snout greatly attenuated. Colour

* We made a description of the identical specimen before it was taken by Mr. Hodgson to England, viz.—"Of a shining rufescent-brown colour, merely weaker on the under parts. Length $3\frac{1}{2}$ in.; of tail $1\frac{7}{8}$ in.; fore-feet and claws $\frac{7}{8}$ in.; the claws alone $\frac{1}{8}$ in., and of a yellow colour, perhaps whitish in the fresh animal; hind-feet and claws $\frac{5}{8}$ in."

blackish-brown, with a rufescent shade to the upper parts; abdomen greyish. From Madras." (Qu. Madras Presidency?)

[S. NIGER, Elliot, appears like a miniature S. GRIFFITHII, but with a long and slender tail. To the description given by Dr. Horsfield, I may add, that the tail, although long and slender (thus differing from the larger examples of this section), has the scattered stiff hairs observable in the species with stout tails, such as S. CÆRULESCENS and S. GRIFFITHII. Fur deep blackish-grey, tipped with glossy-brown, as in the latter-mentioned species, in which, as in S. NIGER, the fur has somewhat of the same glistening appearance so remarkable in some of the aquatic species of Australian mammals, such as the *Ornithorhynchus* and *Hydromys*, and also the *Myogalea* of Europe; but at the roots the fur is not so dense as in these aquatic animals. Head and body 3" 8^{'''}, about; tail 2" 6^{'''}; fore-foot 6^{'''}; planta 9^{'''}. This note has been taken by the kind permission of Dr. Horsfield from the specimen described in his Catalogue of the Mammalia in the Museum of the East India Company.—R. F. TOMES.]

8. S. FERRUGINEUS, Kelaart, J. A. S. xx. 185; *S. montanus*, apud nos (misled by a label), *ibid.* 163, vide xxi. 350, note. *Hab.* Ceylon.

N.B. The dimensions of the specimen described in J. A. S. xx. 163, accord with those assigned by Dr. Kelaart to the next species; and he states that the two are nearly of the same size, and that the smell of the present species is very powerful.

9. S. MONTANUS, Kelaart (nec apud nos, J. A. S. xx. 163). "Length of head and body 3 $\frac{3}{4}$ in.; of tail 2 $\frac{1}{4}$ in.; of hind-foot $\frac{2}{3}$ in. Fur, above sooty-black, without any ferruginous smear; beneath lighter coloured; whiskers long, silvery-grey; lower part of legs and feet greyish, clothed with appressed hairs. Claws short, whitish. Ears large, round, naked; the outer margin lying on a level with the fur of the head and neck, and being thus concealed posteriorly." Mountains of Ceylon ("the blackest Shrew of the highest parts of the island." Kelaart).

N.B. Dr. Kelaart has lately forwarded an entire specimen in spirit of a *young* female Shrew found at Galle(!), though with the three pairs of inguinal teats well developed, which may prove to be the young of S. MONTANUS, but is perhaps distinct and new. If so, S. KELAARTI, nobis. Colour uniform blackish, above and below, slightly grizzled and glistening; the fur short and close, with scattered fine long hairs throughout (as described of S. MONTANUS). Length of head and body 2 $\frac{3}{4}$ in.; of tail 1 $\frac{1}{4}$ in.; and of hind-foot with claws $\frac{5}{8}$ in.

10. *S. PYGMÆUS*, Hodgson, Ann. & Mag. N. H. xv. 269; nec *S. pygmæus*, Pallas; if the small European species referred by Schinz, Rüppell, and others to the latter be correctly identified. *S. PYGMÆUS*, Pallas, apud Schinz, is placed by the latter zoologist among the species with brown-tipped teeth, and in the division of them which corresponds to *CORSIRA*, Gray; and the description—*cauda basi constricta; auriculis brevissimis*—will certainly not apply either to Mr. Hodgson's animal, or to various other minute Indian Shrews hitherto undistinguished from it; and therefore Mr. Hodgson's name for the present species may stand, as he states the structure of the animal to be typical*. The following is his description:—Snout to vent, less 2 in.; tail $1\frac{5}{16}$ in.; head $1\frac{1}{16}$ in.; palma $\frac{1}{4}$ in.; planta $\frac{3}{8}$ in. Structure typical, save that no odorous glands were detected, nor had the animal any musky smell. Colour sooty-brown, paler below. Naked parts of a dusky fleshy hue. *Hab.* Nepal, where it “dwells in coppices and fields, and is rarely found in houses.”

Of numerous species of minute *SORICES* from various localities, the only one which approaches to the above description is a species which we have just procured in Calcutta, curiously enough, while engaged in the investigation of this particular group. It may be termed

11. *S. MELANODON*, nobis, n. s.: from the remarkable colouring of its teeth, which are *piceous* and *white-tipped*; exhibiting thus the reverse coloration of those of *CORSIRA*, &c. Length of adult female $1\frac{7}{8}$ in.; tail $1\frac{1}{16}$ in.; hind-foot and claws $\frac{5}{16}$ in. Colour uniform fuscous, without any rufous tinge; scarcely paler below; the feet and tail subnude, save the usual scattered fine long hairs upon the latter, and with the ears and snout of a livid colour, paler below; claws white, and distinctly visible.

Procured by one of our Museum assistants in his own house, where he states that he has observed and can probably obtain others.

12. *S. MICRONYX*, nobis, n. s. Length of head and body $1\frac{5}{8}$ in.; tail somewhat exceeding $1\frac{1}{8}$ in.; hind-foot and claws $\frac{13}{32}$ in.; skull $\frac{1}{2}$ in. Teeth white. Claws with fine hairs impending them, and so minute as to be scarcely discernible without a lens. Fur of a paler and more chestnut-brown than any other of these minute species examined, and also more silvery below.

* Since writing the above, we have seen the figure of *SOREX PYGMÆUS*, Pallas and Laxman (*S. minutus*, L., *S. exilis*, Gmelin, and *S. minimus*, Geoff.), in the Act. Acad. Leop. vol. xiii. pt. 2. t. 25 (1827), and the species is widely different from all the pigmy Shrews here described, and is evidently a *CORSIRA*.

Feet and tail subnude, or thinly furred, showing the colour of the skin through; browner above, whitish (or perhaps flesh-coloured) below. Of two specimens in our Museum, one in spirit, the other now dried, the latter was obtained by the late Major Wroughton in Kemáon, the former by L. C. Stewart, Esq., of H.M. 61st Foot, at Landour, where, he informs us that he picked up many of them dead, on the surface of the snow, during the severe winter of 1850-51.

13. *S. PERROTETII*, Duvernoy, Guérin's Mag. de Zool. 1842, livr. 8. We can only refer to Prof. Schinz's description of this species, which is as follows:—" *S. notæo saturate fusco-nigricante, gastræo canescente, artubus pedibusque pilosis, auriculis magnis, conspicuis. Long. corporis 1" 4'''*, *caudæ 11'''*." From the Nilgiris. We have a Darjiling female which approximates this description, and may prove to be of the same species. Head and body $1\frac{1}{2}$ in.; tail 1 in.; hind-foot and claws $\frac{1}{3}\frac{1}{2}$ in. Skull somewhat exceeding $\frac{5}{8}$ in. Teeth white. Colour uniform brown, with a slight tinge of chestnut, and scarcely paler below. Feet and tail distinctly furred, besides the usual scattered long hairs on the latter. Claws whitish and conspicuous. Tail brown above, pale and perhaps flesh-coloured beneath; more probably, however, of a livid hue, and tapering evenly throughout. If new, *S. HODGSONII*, nobis.

14. *S. NUDIPES*, nobis, n. s. Remarkable for its naked feet and very large ears; also for the odoriferous glands on the sides being strongly developed, whereas we can detect them in no other of these minute species. Length of female $1\frac{3}{4}$ in.; tail $1\frac{1}{16}$ in.; hind-foot $\frac{1}{3}\frac{1}{2}$ in. Ears conspicuously larger than in the others; tail almost nude, save of the long scattered hairs; and the fore-feet and toes of the hind-feet are conspicuously naked, and apparently flesh-coloured. Fur uniform brown above (like the back of *CORSIRA VULGARIS*), a little grizzled and glistening; the lower parts with a silvery gloss. Tail brown above, pale (probably flesh-coloured) below; somewhat thick and uniformly tapering. Specimen procured at Amhurst (Tenasserim provinces).

[Mr. Blyth has since received two from Pegu.—R. F. T.]

15. *S. ATRATUS*, nobis, n. s. Of this we have only a headless specimen, which was found, impaled upon a thorn by some Shrike*, at Cherra Punji, in the Khásya Hills; but the species

* The same fact we have observed in England of *Lanius collurio* and *Corsira vulgaris*, these diminutive Shrews falling an easy prey to the "Butcher-birds;" while the larger members of the same genus are

is evidently distinct from all the preceding. It is remarkable for its very dark colour, extending over the feet and tail, which is even *blackish underneath*. Length of tail 1 in., and of hind-foot $\frac{1}{3}\frac{1}{2}$ in. Fur blackish-brown above, a little tinged rufescent, and with dark greyish underneath; the feet and tail conspicuously furred, besides the scattered long hairs upon the latter.

Here may be noticed, that the Society formerly possessed a specimen of one of these minute Shrews, which was found in a cellar in Madras, and was presented by Walter Elliot, Esq., Madras Civil Service. We formerly considered it identical with *S. MICRONYX*, so that it could scarcely be so with *S. MELANODON* of Bengal; it was, however, darker than *S. MICRONYX*; and more probably *S. PERROTETII (verus)*, if not distinct from the whole of the foregoing. It is even probable that several more Indian species of these most diminutive of all Mammalia remain to be discriminated. Upon minute comparison of five specimens in our Museum, taken out of spirit and carefully dried for the occasion, we immediately detected four well-marked species, and presently afterwards obtained the *S. MELANODON* fresh. It may be further remarked, that we once found the nearly digested remains of an adult small white-toothed *Sorex*, rather larger than a common mouse, in the stomach of an *Elanus* which was shot on the banks of the Hugli, about fifty miles above Calcutta; but we have since in vain sought to procure the species.

[Since the publication of Mr. Blyth's memoir, he writes me word that he has procured another typical *Sorex*, of which the following is a description:—

S. FULIGINOSUS, Blyth, n. s. Length of an adult female taken from spirits, $5\frac{1}{2}$ in.; tail $2\frac{1}{4}$ in.; foot *plus* $\frac{5}{8}$ in.; skull 1 in., and $\frac{7}{16}$ in. in greatest diameter. Length of series of upper teeth $\frac{7}{16}$ in.; breadth of palate $\frac{1}{8}$ in. Soles bare to the heel; tail with seventeen vertebræ, and perhaps a minute eighteenth at the tip. The scattered long hairs on the tail small and fine. Fur dense, porrect, and somewhat velvety; dark slaty at base, the rest fuliginous-brown, with inconspicuous dull hoary tips; beneath scarcely (if at all) paler. A second specimen differs merely in being a trifle smaller. *Hab.* Schwe Gyen, Pegu.

Besides the foregoing species thus enumerated by Mr. Blyth, are two others, named *S. SATURATOR* and *S. LEUCOPS* by Mr. Hodgson; they have been described by Dr. Horsfield in the

ferociously predatory upon any hapless birdlet they may chance to seize,—as is likewise the case with Moles, and doubtless other *SORICIDÆ* of adequate size and strength.

Number of the Annals for August of the present year. Both are from Nepal.

I shall now proceed to give a description of a Shrew from Mr. Cuming's collection, received by him from Ceylon, where it was captured by Mr. Thwaites.

Forms, those of a typical *SOREX*: teeth white, the lower ones rather less curved at their points than usual. Odoriferous glands considerably developed; ears rather large; tail nearly as long as the head and body, tapering uniformly throughout, appearing naked and finely annulated, but, on being examined with a lens, is seen to be furnished with extremely fine short hairs, besides the usual long ones, which in this species are very fine and thinly set, and not extending for more than one-third the length of the tail. Upper surface of the feet furnished with very small thinly set hairs, appearing almost naked without the assistance of a lens; soles of the feet perfectly naked. Fur rather long, being as much as $2'''$, which is nearly equal to that of the large *S. CÆRULESCENS*; dark, close to the skin, but for the greater part of its length of a grizzled brown, of about the same hue as in *CORSIRA VULGARIS* of Europe; beneath decidedly paler, with a yellowish cast and with a slight silvery gloss. All the naked parts dirty yellowish-brown; upper surface of the tail browner. Upper incisors (projecting from the gum) barely $1'''$; lower ones $1\frac{1}{4}'''$. Length of head and body $2'' 4'''$; head $10\frac{1}{2}'''$; tail $1'' 11'''$; fore-foot and claws $3\frac{1}{2}'''$; hind-foot and claws $6'''$. The above was taken from a male, evidently adult; and a female having the mammæ considerably developed, but with the teeth exhibiting some signs of youth, does not differ except in having the tail a little more slender, slightly quadrangular, and rather more hairy. Colour of the upper parts darker, and of a slaty hue, very slightly tinged with brown; below, grey with a silvery cast, without any tinge of yellow or rufous. Several others, obviously immature, resembled this female in colour, but were somewhat smaller. The only other species from Ceylon, in Mr. Cuming's collection, is the *S. MONTANUS* of Kelaart.

As the species here described appears to differ very considerably from the other small species found in India, I shall propose calling it *SOREX HORSFIELDII*, as a just tribute to that well-known naturalist.—R. F. T.]

Another form of white-toothed Shrew, with thick and tapering tail having scattered long hairs upon it, is exemplified by

FEROCULUS, Kelaart. Teeth small; the upper quasi-incisors shorter and less strongly hooked than in restricted *SOREX*, with the posterior spur large; the lower quasi-incisors serrated, showing two depressions, and therefore a row of three coronal

points; four small upper premolars preceding the *carnassier*, the two medial being of equal size, the first rather large, and the fourth small. Feet remarkably large. The ear-conch scarcely visible above the fur.

16. *F. MACROPUS*. *Sorex feroculus*, Kelaart; *S. macropus*, nobis, J. A. S. xx. 163. Length about $6\frac{1}{2}$ in., of which the tail is $2\frac{1}{4}$ in; hind-foot with claws nearly $\frac{7}{8}$ in.; the fore-foot $\frac{1}{4}$ in. broad, with long and but slightly curved claws, that of the middle digit $\frac{1}{4}$ in. in length. Fur somewhat long and very soft, uniform blackish, very faintly tinged rufescent; the extreme tip of the tail naked and of a flesh-colour. Inhabits Ceylon.

Another white-toothed Indian Shrew exists in the *CROSSOPUS HIMALAYICUS*, Gray, to be noticed presently. We feel much doubt of its being correctly referred to *Crossopus**

The greater number of small Shrews inhabiting the temperate regions of Europe, Asia, and North America, have the teeth always tipped with ferruginous or pitch-colour, a slender mouse-like tail with no scattered long hairs upon it, and (save in *OTISOREX*) the ear-conch concealed amid the fur. There are two distinct types of dentition.

In one, the upper quasi-incisors are much longer than their posterior spur (as in restricted *SOREX*), and the lower have but a single posterior spur more or less rudimental; the lateral small teeth which follow in the upper jaw are four in number (as in restricted *SOREX*), the first two being equal, the third somewhat smaller, and the last (as usual in all Shrews) minute. With this type of dentition we distinguish

1. *SORICULUS*, nobis. With the hind-feet of ordinary form and proportions, unadapted for aquatic habits; and the tail tapering and a little compressed at the extremity.

17. *S. NIGRESCENS*; *Corsira nigrescens*, Gray, Ann. & Mag. Nat. Hist. x. 261 (1842); *Sorex sikimensis*, Hodgson, Horsfield's Catalogue (1851). Length of head and body $3\frac{1}{4}$ in.; of tail $1\frac{1}{2}$ in.; hind-feet and claws $\frac{5}{8}$ in. Number of caudal vertebræ 15 (besides the extreme tip). Colour throughout blackish, a little tinged with rufous; the feet and claws pale. Very common in Sikim, and was formerly sent by Mr. Hodgson to the Society's Museum, and also to the British Museum, from Nepal.

* *Myosorex*, Gray, is founded on a Cape species, the *SOREX VARIUS*, Smuts, with ear-conch concealed amid the fur, and a slender tail (without scattered long hairs?); the teeth white, and the dentition slightly modified upon that of restricted *SOREX*; lower quasi-incisors "with an entire sharp upper edge."

[In a report printed in the J. A. S., bearing the date of Sept. 1854, Mr. Blyth gives a note on this species, which explains more fully the synonymy than does the present memoir, although it bears date more recently than the note alluded to. Mr. Blyth confirms Dr. Gray in referring *S. soccatus*, Hodgs., and *S. aterrimus*, Blyth, to this species; but he goes on to observe, that Mr. Hodgson has since described another, and perfectly distinct species, under the name of *S. soccatus*, which I presume is the *S. SOCCATUS* of the present memoir, a typical SOREX, whilst the former so-called species is the sole example of the genus *SORICULUS*, Blyth.

After explaining its synonymy, and alluding to the species since described by Mr. Hodgson as *S. soccatus*, Mr. Blyth says: "The dentition [*i. e.* of *S. nigrescens*] is that of *CROSSOPUS*, and not of *CORSIRA* (to which group Dr. Gray assigns the species); but this common little Sikim Shrew does not exhibit the modifications for aquatic habits which are characteristic of *CROSSOPUS*, Wagler." The following appears, therefore, to be the synonymy of this species:—

Corsira nigrescens, Gray, Ann. & Mag. Nat. Hist. x. 261. 1842.

Sorex Sikimensis, Hodgs. Ann. & Mag. Nat. Hist. New Ser. iii. 203.

— *soccatus*, Hodgs. Calc. J. N. H. iv. 288 (not described); (?) Ann. & Mag. Nat. Hist. xv. 1845, 270.

— *aterrimus*, Blyth, J. A. S. B. 1843, 128? (not described).

Soriculus nigrescens of the present memoir.—R. F. T.]

2. *CROSSOPUS*, Wagler (*v. Hydrosorex*, N. Duvernoy, and *Pinalia*, Gray). With the hind-feet large and ciliated, and the tail also compressed and ciliated beneath towards its extremity—in adaptation to aquatic habits.

N. B. *S. FODIENS* (*v. hydrophilus*), Pallas, and other Water Shrews of Europe and N. America constitute the types of this division; and Dr. Gray refers to it a Himalayan species, which, having *white teeth*, we very much suspect will prove to differ in other and more important particulars, even though it may exhibit the adaptive characters of an enlarged and ciliated hind-foot and compressed and ciliated tail-tip. It is thus described:—

18. *CR. HIMALAYICUS*, Gray, Ann. & Mag. Nat. Hist. x. 261 (1842). "Length of head and body $5\frac{1}{2}$ in.; tail 3 in.; hind-foot $\frac{3}{4}$ (nearly). Slate-coloured black, with scattered long hairs, which are longer and white-tipped on the sides and rump; lower part of the throat and middle of the belly rusty-brown;

tail elongate, scaly, with appressed dark brown hairs above and elongate rigid whitish hairs beneath, and brown elongated rigid hairs near the tip; feet rather naked; whiskers numerous, elongate, brown. *Teeth white.*" Probably from the neighbourhood of Simla or Masuri.

[The excellent description given by Dr. Gray of this species renders it somewhat unnecessary that I should give a detailed description taken from the same specimen by myself; but having sent one to Mr. Blyth, at his request, it becomes desirable that it should appear here, as any future allusion to it might tend to confuse instead of elucidate. General forms as in the *C. FODIENS* of Europe:—Ears hidden in the fur, very small and hairy. Tail very long and slender, thickly clothed with hair of a stiff nature, from a distance of about half-an-inch from its root to the tip, which has a brush or pencil of hairs about a quarter of an inch long. Nails very short; both fore and hind feet distinctly ciliated. Fur rather long, dusky at base, tipped with shining dark brown on all the upper parts; below the same, but with the tips paler, especially about the throat, which is stained with rufous; above and around the root of the tail are a number of long pale hairs, projecting through the fur for a length of about a quarter of an inch. Head and body about 6"; tail about 3" 6"; hind-foot and claws 11"; fore-foot and claws 6½". The teeth of this example are those of a restricted *SOREX*, and I feel no hesitation in saying, after a careful examination, that they have been introduced by the stuffer; also, in the process of preservation, the tail appears to have been slit up on the under side, thus rendering it difficult to decide whether it was ciliated like the feet; but, from the appearance of the hair on that part, I think that it resembled that of *C. FODIENS*. It is obviously a true *CROSSOPUS*.—R. F. T.]

In the other type of dentition, the lower quasi-incisors are distinctly serrated, with three or four coronal points; and the anterior point of the upper quasi-incisors is not prolonged beyond a level with its posterior spur; the lateral small teeth which follow in the upper jaw are five in number, and diminish gradually in size from the first backward. Tail cylindrical, not tapering, and furnished with a stiffish brush at the extremity. Such is the common British Land Shrew, *S. VULGARIS*, L. (formerly confounded by British writers with *S. ARANEUS*, Schreber), and which is the type of *CORSIRA*, Gray (v. *Amphisorex*, No. 1, Duvernoy, apud Gray). There are many other species*. We refer to it doubtfully.

* *BLARIA*, Gray (v. *Blarina*, Lesson), is founded on *S. TALPOIDES*, Gapper, Zool. Journ. v. 28, referred by Blainville to *S. BREVICAUDATUS*,

19. CR. (?) CAUDATA; *Sorex caudatus*, Hodgson, Horsfield's Catalogue (1851); for the description seems to indicate a species closely affined to the European S. ALPINUS, Schinz, a skull-less example of which, from Mt. St. Gothard, is in our Museum; and S. ALPINUS is ranged among the species having the CORSIRA type of dentition by Prof. Schinz in his 'Synopsis Mammalium;' its tail, however, is naked, and compressed at the tip. "Length of the head and body $2\frac{1}{2}$ in.; of the tail the same, slender, nearly naked, and very slightly attenuated. Colour saturate blackish-brown, very slightly rufescent in certain aspects. Snout moderately elongated, furnished at the sides with long delicate hairs."

[After a very careful comparison of two specimens in the Museum at the India House with a specimen of the C. ALPINUS of Europe, which I had taken there for that purpose, I concluded that C. CAUDATUS and C. ALPINUS were very closely affined, if not perfectly identical. The naked compressed tip of the tail in the last-mentioned species, as remarked by Mr. Blyth, also occurs in one of the examples of C. CAUDATUS; indeed, were this specimen to be placed along with the European species, it would be almost impossible to distinguish them.

It is probable that many Himalayan species may be found to be identical with European ones; certainly among the Cheiroptera, the *Plecotus* and *Barbastellus* of Mr. Hodgson are identical with the European representatives of those genera, as I have ascertained by actual comparison; and the VESPERTILIO DARJELINGENSIS of that naturalist differs only from our V. MYSTACINUS in having the tips of the fur of the back brighter.—R. F. T.]

We now conclude this effort at a *Conspectus* of the Indian SORICINÆ by soliciting aid from all (probably not many persons in India) who take any interest in the subject. It will suffice if specimens could be sent in spirit to the Museum of the Society (if disembowelled, and the abdominal cavity cleaned of blood, so much the better for our present purpose, except with regard to the very diminutive species, examples of which are particularly acceptable), such being far preferable to badly prepared skins for being afterwards set up as stuffed specimens, besides permitting of much more satisfactory examination of their differential characters; and it is further desirable that

Say, a N. American species, which, we believe, only differs from CORSIRA in the large size of its fore-feet and in its very short tail:—and OTISOREX, DeKay, is founded on two minute N. American species, which do not appear to differ from CORSIRA except in having the ear-conch large and conspicuously visible above the fur.

three or four adults of each kind should be thus transmitted, to supply our collection with skeleton and stuffed specimens, in addition to at least one to be retained entire in spirit. The *micro-mammalia*, as they have been designated (as Bats, Shrews, Mice, &c.), require to be thus amply represented in museums, for their specific distinctions to be rightly understood in many cases; and the chaos of Indian MURIDÆ, in particular, will be never reduced to systematic order, with the synonyms correctly adjusted, until such a tolerably complete collection of them from all quarters has been brought together.

[The notes appended to the present memoir were most of them taken from specimens in the British and India-House Museums, at the request of Mr. Blyth, and kindly permitted by Dr. Gray and Dr. Horsfield; but having reached Calcutta too late for insertion, Mr. Blyth has requested me to add them to his memoir, and have the whole republished in the 'Annals and Magazine of Natural History.' I have acted in accordance with his wishes, and also added references to two species described by Dr. Horsfield, and given the description of what appears to be hitherto an undescribed species, in order to render it as complete a monograph of the Indian species as circumstances would permit.—R. F. T.]

IV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.*
By THOMAS WILLIAMS, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[With a Plate.]

[Continued from vol. xvi. p. 421.]

Pectinibranchiata.

THIS order comprehends a considerable number of families and genera. It is the largest and most important group of the Gasteropod Mollusks. In this summary it will be impossible to present a correct analysis, derived from personal observation, of the respiratory organs of every genus. If that were possible indeed to a single observer, an acquisition of great value would accrue to science. The author is deeply persuaded that even in such minute constituents of the organism as a *single* leaflet from the branchial apparatus, the microscope may reveal the presence of differences of shape, size, structure, &c., which may